STENOPORIDS FROM THE PERMIAN OF NEW SOUTH WALES AND TASMANIA.

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(Plates ii–iii; twenty-five Text-figures.)

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Introduction.

By far the greatest development of Bryozoa in the Palaeozoic of Australia occurs in the Permian. Great thicknesses of marine deposits of Permian age occur in Western Australia, Northern Territory, Queensland, New South Wales and Tasmania, and in all of these Bryozoa are extremely abundant, forming in many places thick bryozoal limestones and shales. The bryozoan faunas fall into two provinces, the Eastern Australian, comprising the faunas of Queensland, New South Wales and Tasmania, and the Western Australian, which includes also those of the Northern Territory. Although the marine beds in which they occur are believed to represent a similar range of time during the Permian, and although several individual species are common to Eastern and Western Australia, the general type of fauna in these two provinces is widely dissimilar.

From Western Australia, species belonging to twenty genera of the families Fistuliporidae, Batostomellidae, Fenestrellinidae, Acanthocladiidae, Rhabdomesontidae, and Sulcoreteporidae have so far been described, and a number of other genera is known to occur in the fauna; with the exception of the Acanthocladiidae, which are, however, fairly common, representatives of all of these families are extremely abundant.

In Eastern Australia, the total number of genera so far known to occur in the Permian is twelve, belonging to four families: Batostomellidae (*Batostomella*, *Dyscritella*, *Stenopora*, and *Stenodiscus*, n. gen.), and Fenestrellinidae (*Fenestrellina*, *Polypora*, *Protoretepora*, *Minilya*), which are extremely abundant; and Rhabdomesontidae (*Rhombopora*; and also *Streblotrypa*, which occurs very rarely and has not so far been recorded) and Acanthocladiidae (*Ptilopora*; and *Penniretepora*, which is also unrecorded), both of these families being very sparsely represented. Since the collections which have already been made are, in the case of those from New South Wales and Tasmania at least, very extensive, it is improbable that the number of genera will be greatly increased by further collecting, or that abundant representatives of the Fistuliporidae and Sulcoreteporidae, characteristic of the Western Australian Permian, will be found to occur here. In spite of this it is hoped that as work progresses on the faunas of both areas, more species of Bryozoa will be added to the few already known to be common to the two areas.

The faunas throughout the Upper and Lower Marine Series of New South Wales and of the Permian sequences in Tasmania have been considered extremely uniform. Many species of Bryozoa common in these deposits are, however, both widespread geographically and of restricted geological range, and distinct faunas are found where similar facies are developed at different horizons; for example, Fenestrellinidae are especially abundant in the Hunter River district of New South Wales on two horizons, one just above the Eurydesma Horizon in the Allandale Stage of the Lower Marine Series, and the other in the Fenestella Shales of the Branxton Stage of the Upper Marine Series, but although there are species which occur on both horizons, other species are abundant and widespread on one or other of these horizons, but are not common to both; and other examples occur of similar facies (characterized by an abundance of Fenestrellinidae or of ramose or massive Batostomellids) containing distinct faunas when they are developed on different horizons. Because of this, it is hoped that when the Bryozoa from the Hobart district, where the Permian sequence is very much faulted, are better known, they may be useful in correlating these outcrops with the New South Wales sections.

Of the Batostomellidae occurring in the Permian of Eastern Australia, the most abundant genus is *Stenopora*, many species of which occur abundantly at different localities and on different horizons throughout the sequence. Massive and ramose forms make up the greater number of those occurring here. Some of these forms should be of great value stratigraphically, as they appear to be very short ranged, and are in some cases of wide geographical distribution. Before reliance can be placed upon them in correlation, identification of species of this genus must, however, be made from an examination of their internal as well as their external structure, although once a species has been described, additional specimens can in some cases be identified from casts of the surface, provided the cast is well preserved and shows clearly the size and shape of the zooecial apertures, the number and arrangement of the acanthopores and mesopores, the occurrence of monticules or maculae and the differences in zooecial structure associated with them; many records have been made of the occurrence of described species of *Stenopora*, so that published records indicate that individual species occurring in Eastern Australia are long-ranged geologically; these records have frequently been based on an examination of the general form of the zoarium alone, and where details of the external structure and the internal structure have been examined, a wide variety of internal structure has usually been ascribed to the one species; these records have, therefore, in general no value beyond recognition of the occurrence of fine ramose (as "*Stenopora tasmaniensis*"), coarse ramose (as "*Stenopora ovata*") or massive (as "*Stenopora crinita*") species of the genus at different localities. Upon a number of occasions, these species have also been recorded from the Upper Palaeozoic of India; these records also have no more significance than recognition of the occurrence of similar growth-forms of the same genus; in some cases they have been based merely upon the occurrence of an impression of the surface of either a ramose or a massive bryozoan, but in spite of this, their occurrence has been quoted by different workers in support of correlations between the Indian and Australian sequences. *Stenopora ovata* has also been recorded from the Upper Carboniferous of Russia (Nikiforova, 1933, 8), but this record also apparently refers only to a species of similar form.

The two previously recorded species which are revised in this paper both occur in Tasmania as well as in New South Wales. In New South Wales, *Stenopora crinita* occurs typically in the highest beds of the Upper Marine Series, the Mulbring Stage of the Hunter River district and the Crinoidal Shales of the South Coast; small zoaria of this species occur in the Muree Stage, which underlies the Mulbring Stage in the Hunter River district, and in beds of similar age in other localities; this species occurs in Tasmania at Eaglehawk Neck, in the highest marine beds of the Permian sequence. One of a collection of specimens recorded as this species from the Dilly Stage in the Springsure district of Queensland has been examined and found to belong to a distinct species. *Stenopora johnstoni* Etheridge, 1891, described by Etheridge and later revised by Hummel (1915) from material from Porter's Bay, near Hobart, and from beds near the base of the marine sequence on Maria Island, has been found to occur also at a number of localities in the Allandale Stage of the Lower Marine Series in New South Wales.

In addition to the revisions of these two species, a discussion is given here of the characters of *Stenopora ovata* Lonsdale, 1844, which was originally described from the Permian of Tasmania, and has since been frequently recorded from many different localities.

Description of Species.

Order Trepostomata Ulrich.

Family Batostomellidae Ulrich.

Genus Stenopora Lonsdale, 1844.

Stenopora crinita Lonsdale, 1845. Text-figs. 3, 4.

Stenopora crinita Lonsdale, 1845, 265, Pl. viii, fig. 5, 5*a*; *Chaetetes crinitus* (Lonsdale), Dana, 1849, 711, T. xi, fig. 7; *Stenopora crinita* Lonsdale, Nicholson and Etheridge, 1886, 182, Pl. iv, figs. 1–3, [?] 4, 5, [?] text-fig. 2 A, B; Etheridge, 1891, 49, Pls. ii, iii, iv, fig. 2, v, figs. 1–4, vi, figs. 3–6, vii, fig. 1, [?] fig. 2.

Lectotype (selected by Nicholson and Etheridge, 1886, 183): is in the British Museum; the specimen was collected by Strzelecki from "Illawarra, New South Wales".

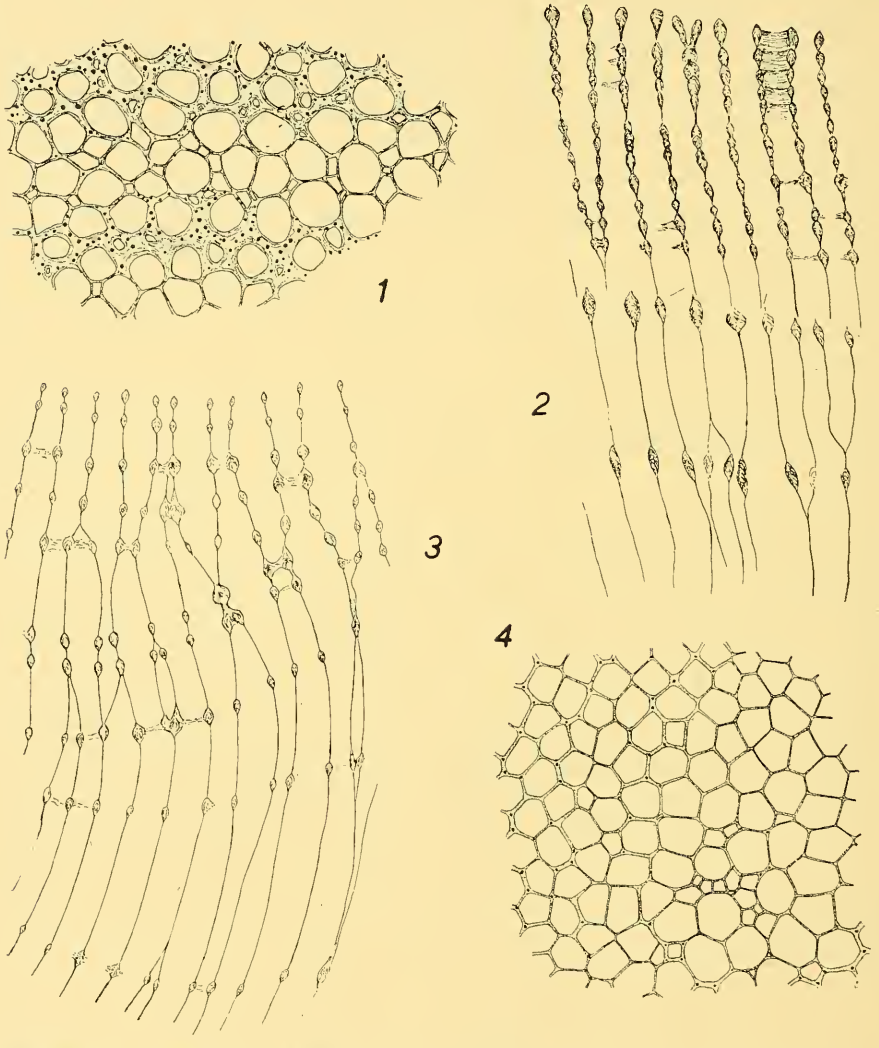
Occurrences: *Stenopora crinita* first appears in the Muree Stage of the Upper Marine Series at Abbey Green, near Singleton, and in rocks of similar age at Bundanoon, in the South-western Coalfield, and at each of these localities the zoaria, though fairly common, are small, not exceeding 2 inches in height; the species is abundant in the Mulbring Stage in the Hunter River district, and occurs at the northern end of the Singleton Railway Bridge, in railway cuttings about 1 mile towards Wittingham from Minimbah Platform, and at Bylong; in the South Coast (Illawarra) district it occurs at Wollongong and at Broughton village, near Berry, in the Crinoidal Stage (equivalent to the Mulbring Stage of the Hunter River district), and in the Westley Park Tuffs of the Crinoidal Stage at Black Head, near Gerringong, and in numerous outcrops of these tuffs on the coast between Gerringong and Kiama (specimens F 381, F 12267, F 19872–3, F 35541, F 37070, Australian Museum Collection, and 430, 5445–9, Sydney University Collection). In Tasmania it occurs in the highest marine beds of the Permian sequence at Eaglehawk Neck (5441, Sydney University Collection) and at Fitzgerald (Tasmanian Geological Survey specimens). It has been recorded (Whitehouse, 1930, 156) from the Dilly Stage in the Springsure district of Queensland; one of these specimens has been available for examination; it is a massive species distinguished from *S. crinita* by the possession of very numerous acanthopores and other differences in internal structure.

Large, massive Stenopora, *with polygonal zooecia, thin-walled and with fine distant monilae; surface with regularly placed monticules; mesopores rare, except in the monticules; diaphragms practically absent; acanthopores small, not numerous, occurring at the angles of the zooecial tubes.*

The zoarium is massive, very variable in shape, the upper surface being smooth to strongly lobate; zoaria up to at least 1 ft. in diameter are frequently developed; the base is usually attached to a shell or a small pebble. It is not often possible to detach the upper surface of the colony from the matrix, but when exposed it shows raised monticules, from 3 to 4 mm. in diameter, which are placed with their centres from 8 to 13 mm. apart in specimens from Gerringong and with slightly closer average spacing in specimens from Singleton; these monticules are raised about 1 mm. above the general level of the surface, and are differentiated from the remainder of the surface by their usually larger zooecia and by the greater number of mesopores they contain. Typically, the zooecia extend continuously from the base of the zoarium to the periphery, and so may be 6 in. or more long, but in some specimens the zoarium is built up of several discontinuous layers of zooecia of variable width, usually at least 1·5 cm. wide. The presence of fine monilae about 2 to 4 mm. apart in the zooecial walls gives broken colonies the stratified appearance described by Lonsdale, Nicholson, and Etheridge. The tubes are polygonal (generally six-sided) and angular, and are usually from 0·35 to 0·55 mm. in diameter, and the number usually occurring in 7 sq. mm. is from 28 to 50; in the monticules the zooecia are larger than over the rest of the surface, being up to 0·9 mm. in diameter; some monticules can be distinguished in sections only by the size of the zooecia, but at times these larger zooecia are accompanied by aggregations of mesopores, as shown in Text-fig. 4; up to about 17 mesopores may occur in each monticule.

In sections, the zooecial walls are normally very thin, but increase to 0·13 mm. in width at the level of the monilae, which are pyriform, with their greatest diameter near the upper end; individual monilae are up to 0·43 mm. long; they are usually fairly evenly spaced, between 2 and 4 mm. apart, but are much more crowded in the outer 5 mm. of the colony (Text-fig. 3). The thickened walls at the level of the monilae may, when cut obliquely in vertical sections, give the appearance of a broad diaphragm, and were figured as such by Etheridge (1891, Pl. vii, fig. 1) and by Nicholson and Etheridge (1886, Pl. iv, fig. 5, and Text-fig. 2 B), who state (p. 184) that: "Tabulae are developed from these nodal points, but vary much in their numbers." True complete diaphragms, in the form of very thin, slightly concave plates, are developed at extremely distant intervals, and are so rare that they are virtually absent from the tubes; they

are not necessarily placed at the level of the monilae, nor are they developed at the same level in adjacent zooecia. Young zooecial tubes cut in transverse section show as angular tubes much smaller than the average; the monticules may be marked by large numbers of mesopores. The epitheca covering the surface between successive layers of zooecia in specimens in which several layers of zooecia are developed, and which covers the base of the colony, is a thin undulating plate; the zooecia are horizontal for a short distance immediately above this epitheca, which is composed of the horizontal portion of the wall on the lower surface of the tube, then they bend gradually to become vertical within 3 mm. A single acanthopore frequently occurs at the angles of the zooecia; they are shown best at the level of the monilae, but are often difficult to distinguish,



Text-figs. 1-2.—*Stenopora spiculata*, n. sp. Thin sections of the holotype, × 10. 1. Tangential section, passing through a monticule. 2. Longitudinal section, passing from the surface, near which the monilae are closely spaced, in towards the central part of the zoarium.

Text-figs. 3-4.—*Stenopora crinita* Lonsdale. Thin sections of specimens from Gerringong (6400, 6401, Sydney University Collection), × 10. 3. Longitudinal section, showing the small monilae, closely spaced near the surface, and becoming widely spaced towards the central part of the zoarium. 4. Tangential section; the larger zooecia and abundant mesopores in the lower part of this diagram mark the position of a monticule.

All the text-figures were drawn with the aid of a *camera lucida*.

especially in the thin-walled portions of the tubes; as Etheridge has noted (1891, 41, 53), their distribution is variable, and they are sometimes fairly abundant in one part of a section, but not common in other parts of the same slide.

Nicholson and Etheridge (1886, 182) figure sections of the holotype of this species (Pl. iv, figs. 1–3), which is in the British Museum Collection. They described as "tabulae" the wide bands seen when the monilae are cut obliquely in longitudinal sections, and state that:

> "The growth of the corallum was periodic, and the entire mass . . . is stratified, the polygonal corallites showing a slight transverse wrinkling as they approach the upper surface of each successive stratum. It seems almost certain, however, that the type-specimen is only the central portion of a large corallum of which none of the outer portion is preserved; and there is therefore no reason to doubt that the corallites in the peripheral region of the corallum would exhibit the characteristic annulations of the genus"

—which they state that they had observed in other specimens of this species; fine monilae of the type characteristically found in the central part of zoaria of this form are, however, well shown in the sections of the holotype which they figure. Etheridge (1891) has described and figured a large number of specimens and sections of this species; the infilling of the tubes, which he describes, is frequently developed in specimens from all the localities. The external form of the colony varies very considerably from massive to coarsely lobate (not ramose), but this variation is not accompanied by any differences in internal structure, and is not, therefore, of taxonomic significance.

Stenopora informis Lonsdale, 1845, is, according to Nicholson and Etheridge, differentiated from *S. crinita* by possessing smaller, cylindrical zooecial tubes.

STENOPORA SPICULATA, n. sp. Text-figs. 1, 2.

Holotype: 5422, Sydney University Collection.

Horizon and locality: Allandale Stage, Lower Marine Series, Por. 34, Par. Middlehope, near Eelah Rd. crossing of North Coast Railway.

Massive Stenopora, *zooecial walls with prominent monilae, especially in the peripheral region; acanthopores large, numerous, up to 16 around each tube; mesopores not numerous, except in the monticules; diaphragms absent.*

The zoarium is massive, the lower surface of the holotype is infolded, and the upper surface is very irregular and is thrown up into a number of folds. The colony is about 7 cm. in diameter and up to 5 cm. high. The upper surface could not be freed from the matrix, so that the development of monticules is not shown, but their occurrence is indicated in sections by the presence of small areas, their centres 5 to 7 mm. apart, in which mesopores are more numerous.

The zooecial tubes are angular where they are thin-walled and oval at the level of the monilae; their diameter is between 0·4 × 0·36 and 0·87 × 0·6 mm. between, and 0·34 to 0·5 × 0·3 to 0·43 mm. at the level of the monilae, being rather larger in the monticules than between them. The monilae are more crowded at the periphery, where there are about twelve rows in the outer 4 mm. of the zoarium, than they are in the central part, where single rows of monilae spaced 1 to 3 mm. apart usually occur: rarely a zone of four or five rows of closely spaced monilae occur in this part of the zoarium. The walls are up to 0·22 mm. thick at the level of the monilae. No diaphragms occur. Mesopores are not numerous, except in the monticules, where they are slightly more numerous than the zooecial tubes; they do not at any time completely separate the zooecial tubes. In 7 sq. mm. there are 20 zooecia, with 26 mesopores, where a monticule is included in the field, and 33 to 36, with 1 to 5 mesopores, between the monticules. Large acanthopores occur in a single row in the tube-walls, and at the surface up to 16, but usually 12 or less, occur around each aperture.

This species resembles, in the form of its zoarium, the common *Stenopora crinita* of the higher part of the Upper Marine Series; it is readily distinguished, however, by its internal structure, and on weathered surfaces the spacing of the rows of monilae in the central part of the colony is closer than in *S. crinita*.

STENOPORA RUGOSA, n. sp. Pl. ii, fig. 1; Text-figs. 5–7.

Holotype: 414, Sydney University Collection.

Horizon and locality: Fenestella Shales, Branxton Stage, Upper Marine Series, railway cutting 1 mile west of Branxton.

Discoid Stenopora, *with prominent regularly placed monticules; monilae strongly developed; large acanthopores fairly abundant; mesopores not numerous.*

The zoarium is discoid, the largest specimen examined being 10·5 cm. long and 9 cm. wide, and about 2·3 cm. high at its thickest part, tapering gradually towards the periphery. The base is attached to a shell or pebble. The upper surface is convex, and shows prominent, very regularly placed monticules, each about 3 mm. wide and raised, where the surface is well preserved, about 2 mm. above the surface, but they are rather rapidly removed by weathering; the distance between the centres of adjacent monticules is 7 to 9 mm. The zooecia in the monticules are thicker-walled than those between them, and the acanthopores in the monticules are greatly thickened. Mesopores are more numerous in the monticules than over the rest of the surface, but they are never abundant. The interspaces between adjacent zooecia are usually rather sharply curved, but are broad and flat where the walls are more strongly thickened; about six acanthopores surround each aperture, being most frequently developed at the angles of the zooecia; they form short, rather blunt spines, and are greatly thickened in the monticules.

The zooecia are tubular; between the monilae they are angular and are from 0·36 in their shorter to 0·51 mm. in their longer diameter; they are rounded and correspondingly smaller at the level of the monilae, where the zooecial walls are up to 0·25, but usually 0·1 to 0·15 mm., thick. The monilae are short and usually almost confluent. Mesopores are not abundant; they are rounded at the level of, and angular between, the monilae, and are up to 0·22 mm. in their longer diameter. No diaphragms occur. In a field of 7 sq. mm. there are about 19 to 23 zooecia and 14 to 19 mesopores where the area measured includes a monticule, and 33 to 37 zooecia and 6 or 7 mesopores measured between the monticules.

STENOPORA CONTIGUA, n. sp. Text-figs. 8–10.

Holotype: 5431, Sydney University Collection.

Horizon and locality: Muree Stage, Upper Marine Series, base of cliff section of this Stage in Loder's Ck., north of road leading to house, Abbey Green, near Singleton.

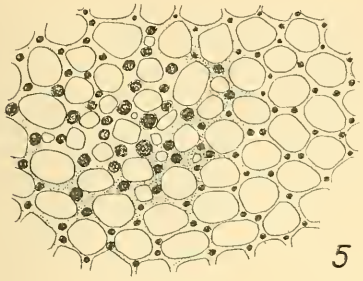
Discoid Stenopora, *with small, closely spaced monticules; monilae strongly developed, not confluent; mesopores rare, except in the monticules; acanthopores large, developed at the angles of the tubes.*

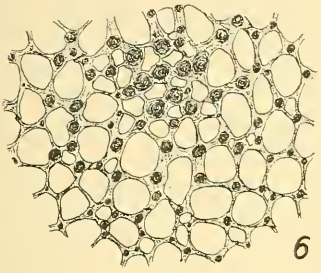
The zoarium is discoid, the holotype is 5·4 cm. in diameter and is rather less than 1·5 cm. in height at the centre, tapering towards the periphery. Regularly placed small monticules, each about 2 to 2·5 mm. in diameter, and with their centres 4·5 to 6·5 mm. apart, occur on the upper surface; these monticules are raised about 1 mm. above the surface, and are differentiated from the rest of the surface by their thicker-walled zooecia and by their greatly thickened acanthopores, and also by containing more abundant mesopores than the rest of the surface.

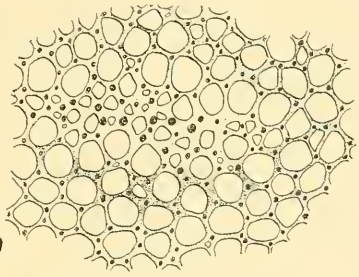
The zooecia are tubular, and are angular between and rounded at the level of the monilae, where they are from 0·3 to 0·43 × 0·33 to 0·45 mm. in diameter; the walls are from 0·06 to 0·13 mm. thick at this level, so that the tubes are correspondingly slightly larger in the thin-walled zones between the monilae. The mesopores are usually small, from 0·03 up to 0·11 × 0·22 mm. in diameter. Acanthopores are developed usually at the angles of the tubes, and up to five or six surround each aperture; the acanthopores in the monticules are strongly thickened. No diaphragms occur. The monilae are usually separated by a short thin-walled zone and are not confluent. In 7 sq. mm. there are usually 45 to 50 zooecia and 1 to 6 mesopores; where a monticule is included in the field there are about 38 to 40 zooecia and 10 to 18 mesopores in the same area.

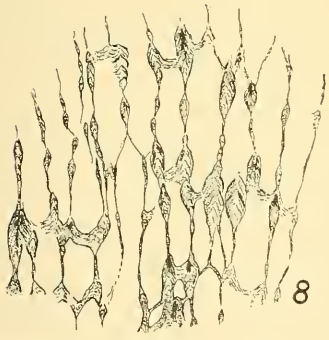
This species is differentiated from *Stenopora rugosa*, n. sp., which occurs on a lower horizon in the Upper Marine Series, by its smaller and more closely spaced monticules,

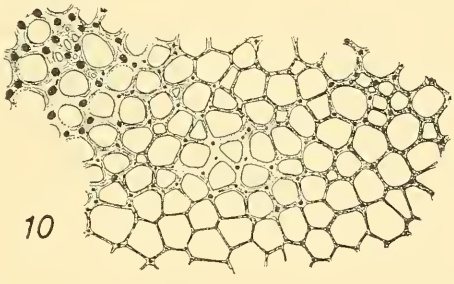
in which the mesopores are rather more abundant, and by the more distant monilae in the zooecial tubes, and by its smaller, more closely spaced zooecia.











Text-figs. 5-7.—*Stenopora rugosa*, n. sp. 5. Part of the surface of the holotype, including a monticule, × 10. 6. Tangential section of the holotype, × 10, passing through a monticule in the upper part of the section. 7. Longitudinal section of the holotype, × 10; the section passes through the thick-walled tubes of a monticule near the right-hand side.

Text-figs. 8-10.—*Stenopora contigua*, n. sp. 8. Longitudinal section of the holotype, × 10. 9. Part of the surface of the holotype, × 10, with a monticule shown in the centre of the diagram. 10. Tangential section of the holotype, × 10, passing through parts of two monticules.

Stenopora ovata Lonsdale, 1844.

Stenopora ovata Lonsdale, 1844, 163; *Stenopora ovata* Lonsdale, Lonsdale, 1845, 263, Pl. viii, figs. 3–3B; Nicholson and Etheridge, 1886, 173, Pl. iii, figs. 1–4; [non] *Stenopora ovata* Lonsdale, Auctt.

Lonsdale, in 1844, briefly described this species from material collected by Darwin from the southern part of Tasmania. In the following year, he gave a much longer description, accompanied by three figures, of this species, based on additional specimens collected by Strzelecki from Mt. Wellington, Mt. Dromedary and Norfolk Plains in Tasmania. The original specimen collected by Darwin is now lost; Strzelecki's figured specimen was placed in the British Museum Collection, and thin sections of this specimen have been figured by Nicholson and Etheridge (1886), who (pp. 174, 175) considered this specimen the type, as did Etheridge (1891, 56).

The original descriptions do not form an adequate basis for any records of the occurrence of this form, nor are the figures of thin-sections given by Nicholson and Etheridge good enough to show definitely which of several ramose species occurring in the Permian of the Hobart area of Tasmania should be identified with this species. From the published descriptions, the type specimen is a ramose zoarium, 1/6 in. to 5/12 in. in diameter, in which the mature zone, with crowded monilae, occupied about one-half of the radius, and the central axial zone with thin-walled zooecia is crossed by rather distant arcuate rows of monilae; mesopores were not abundant; large acanthopores occur at the angles of the tubes; the monilae in the mature region were closely spaced and rather elongate; diaphragms were (apparently) absent; the diameter of the zooecial tubes (according to measurements on figures given by Nicholson and Etheridge) is about 0·33 to 0·54 mm.

Later authors have referred many different species of coarse ramose Bryozoa to *Stenopora ovata*, relying almost entirely on the external form of the zoarium for their identifications; as a result of this, records of the occurrence of this species, which has been recorded from India and Russia as well as from Australia, are numerous, and on several occasions its occurrence has been quoted in support of correlations between Australian and Indian sequences; but without a revision of this species, based on the specimen figured by Lonsdale in 1845, it would be impossible to recognize this form with any certainty. Because of this, none of the coarse ramose species from the Permian of Tasmania described in this paper is referred to *Stenopora ovata*.

STENOPORA PUSTULOSA, n. sp. Pl. ii, figs. 2, 3; Text-figs. 22, 23.

Holotype: 5436, Sydney University Collection.

Horizon and locality: Berriedale Limestone, Rathbone's Quarry 2 miles upstream from Granton, near Hobart (holotype); same horizon, Collinsvale Quarry, near Hobart (5438, Sydney University Collection); Telosa Rd., Glenorchy, near Hobart (5439, Sydney University Collection); Newtown, near Hobart (5440, Sydney University Collection); and Huon Rd., Mt. Wellington, 1,000 ft. above sea-level (2426, Sydney University Collection).

Coarse ramose Stenopora, *surface when well preserved with prominent monticules; zooecial tubes without diaphragms, walls with numerous closely-spaced monilae in the peripheral zone and a few arcuate zones of monilae crossing the axial zone; acanthopores large, placed usually at the angles of the tubes; mesopores almost restricted to the monticules, in which they are abundant.*

The zoarium is ramose, arising from an encrusting base and branching irregularly; the branches are typically cylindrical, but are readily crushed and distorted; they are usually 2 to 2·7 mm. in diameter, but are not always of very constant diameter, and the main branch of the holotype gives off two lateral branches firmly imbedded in the matrix, which were probably not more than 1·5 cm. wide. The surface of the branches shows prominent monticules, usually about 3 mm. in diameter and with their centres spaced 4·5 to 7 mm. apart; these monticules are raised about 1·5 mm. above the general level of the surface and in them the zooecia are thicker-walled and sometimes larger, and the acanthopores, and especially the mesopores, are more abundant. These monticules are very noticeable when the matrix has been weathered completely away from the surface; they are, of course, less obvious when any of the matrix still adheres to the hollowed parts of the surface between them, and they are also readily removed by weathering of the surface; but they are always prominent in sections, and the difference in the numbers of acanthopores and mesopores and in the thickness of the zooecial walls can still be seen on close examination of the surface of weathered specimens; the monticules, and the difference in zooecial characters which occurs in them, can also be distinguished in well-preserved casts of the surface.

The zooecia are tubular, rounded in cross-section at the level of the monilae, where they are usually from 0·27 to 0·36 mm. in their shorter and from 0·35 to 0·43 mm. in their longer diameter, although a few zooecia up to 0·48 × 0·55 mm. occur; these larger zooecia usually occur in the monticules, but on the whole, the zooecia in the monticules are very little larger than those elsewhere, but they are much thicker-walled than usual.

The thickness of the walls at the level of the monilae is usually about 0·11 mm., but may be up to 0·2 mm. The zooecia are angular in section between the monilae, where they are very thin-walled and the diameter of the tubes is correspondingly increased. The axial zone comprises approximately one-half of the radius of the zoarium, and here the zooecia are thin-walled; arcuate zones of single monilae cross this zone at intervals of about 3·5 to 11 mm., being usually about 7 mm. apart. The tubes bend rather gradually from the axial to the mature zone, where small, closely spaced, and distinct monilae are developed in the walls of the zooecia; in the outer 3 mm. of the zoarium there are about 11 to 14 rows of these constrictions. Large acanthopores are developed at the angles of the zooecia and occasionally in other parts of the walls; they frequently indent the zooecial tubes, and from 5 to 10 surround each tube; as well as these, small acanthopores are occasionally developed. No diaphragms occur. Small mesopores are fairly abundant in the monticules, but occur only occasionally over the remainder of the surface. In 7 sq. mm. there are normally about 35 to 43 zooecia and 4 to 8 mesopores, but from 30 to 41 zooecia and 15 to 35 mesopores occur where a monticule is included in the field.

This large ramose species closely resembles the original illustrations of *Stenopora ovata* Lonsdale in its general appearance. It is of such similar size, and fractured surfaces so closely resemble Lonsdale's figure of *S. ovata* that it is possible that it is the same species. For two reasons, however, it is here considered preferable to give this form a new name until its identity with *Stenopora ovata* can be confirmed definitely. Firstly, coarse ramose Stenoporids are abundant in the Permian strata of the Hobart district, and there are other species of similar size and general appearance which could equally well be compared with *S. ovata*; Nicholson and Etheridge (1886, 174–5) have selected the specimen figured by Lonsdale as the neotype of *S. ovata*, and comparison of the specimens here described with the neotype would be necessary to definitely identify this form with *S. ovata*; although both Lonsdale (1845, 263) and Nicholson and Etheridge (1886, 173) have given long descriptions of the specimen figured by Lonsdale, none of these authors mentions the monticules which are so prominent on the surface and in thin sections of *S. pustulosa*, and the figures of thin sections given by Nicholson and Etheridge are very small and do not adequately illustrate the characters of the species; if their magnifications are correct, the tubes in the type of *S. ovata* are larger than in these specimens (unless the tubes in Nicholson and Etheridge's figure are drawn from a monticule, in which case the mesopores would probably be more numerous than they are shown), and also the monilae are very much longer in the figures of *S. ovata*—2 of the monilae in *S. ovata* being equivalent to 5 or 6 in *S. pustulosa*. Secondly, the name "*Stenopora ovata*" has been so indiscriminately applied to such a wide variety of forms in Eastern Australia, India and Russia that, until this characteristic form from the Berriedale Limestone can be directly compared with the neotype, it is better to give it an unambiguous new name which will permit its use in local stratigraphy without the confusion which the name "*Stenopora ovata*" at present implies.

Stenopora hirsuta, n. sp. Pl. ii, fig. 6; Text-figs. 11–13.

Holotype: F 3200, Commonwealth Palaeontological Collection.

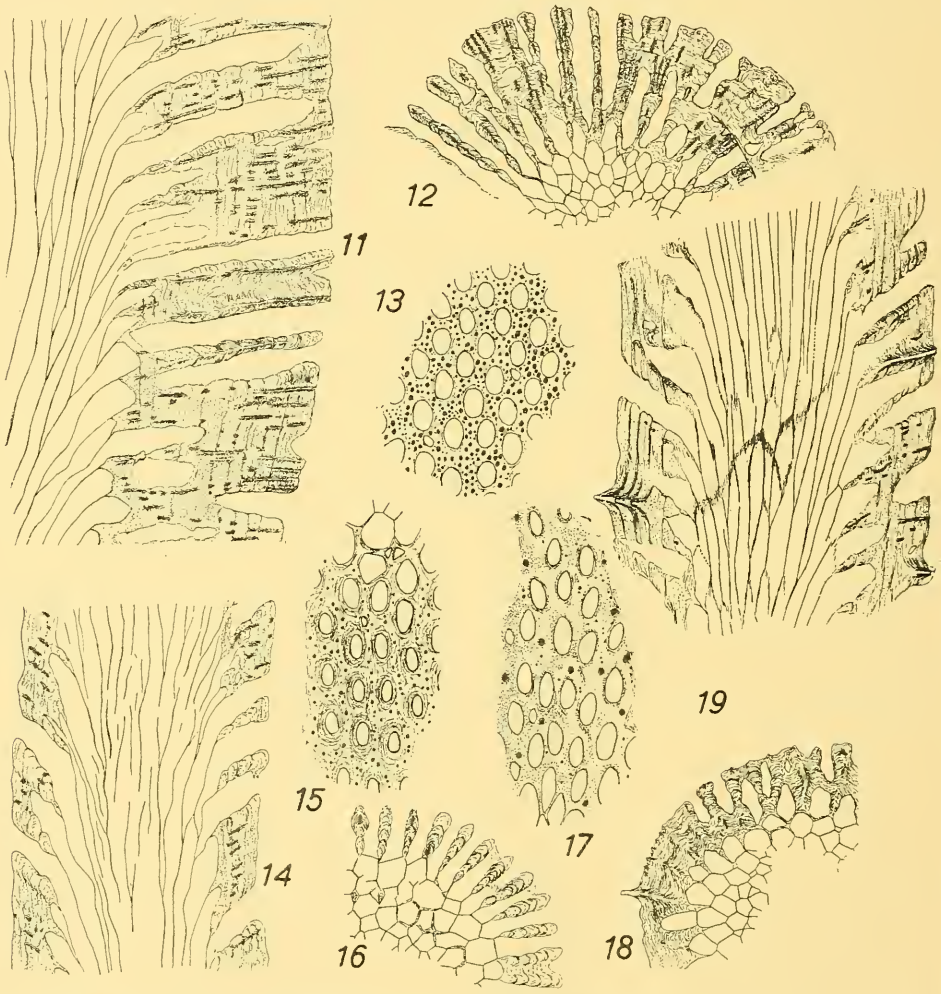
Horizon and locality: Berriedale Limestone, Granton, opposite Bridgewater, near Hobart (holotype); same horizon, Collinsvale Quarry, near Hobart (5442, Sydney University Collection); same horizon, Rathbone's Quarry, 2 miles upstream from Granton (6419, Sydney University Collection).

Coarse ramose Stenopora, *surface with occasional small maculae; zooecial tubes without diaphragms; walls with numerous, almost confluent monilae in the peripheral zone, which makes up one-third to one-half of the radius, thin except where crossed by occasional arcuate rows of monilae in the axial zone; acanthopores very abundant, in two or three rows between the apertures; mesopores rarely developed.*

The zoarium is ramose, composed of cylindrical branches 6·5 to 8 mm. in diameter, and branches at an acute angle at distant intervals. The surface is smooth, with occasional spot-like or elongate maculae in which the zooecia are thicker-walled and the mesopores and acanthopores more abundant. The zooecial apertures are oval, with their

longer axis parallel to the direction of growth, and are 0·32 to 0·41 mm. long and 0·21 to 0·3 mm. wide. The interspaces between the apertures are flattened and bear numerous acanthopores; these occur in one, more usually two or three, rows on each interspace, and about 20 surround each aperture; the acanthopores are of two sizes, the larger ones being more abundant than the smaller. The apertures are irregularly arranged, there are about 10 to 12 in 5 mm. longitudinally, and about 38 to 42 in 7 sq. mm., with 1 or 2 mesopores in the same area; the mesopores are slightly more numerous in the maculae.

The zooecial tubes are thin-walled in the axial zone, which comprises one-third to one-half of the radius; in the mature zone the walls are up to 0·22, but usually about 0·15 mm., thick between two apertures transversely, and up to 0·3 mm., but usually about 0·2 mm., thick longitudinally; the monilae are long and are almost confluent. The zooecia bend rather sharply from the axial to the mature zone. No diaphragms occur.



Text-figs. 11-13.—*Stenopora hirsuta*, n. sp. Thin sections of the holotype, × 10. 11. Longitudinal section. 12. Transverse section. 13. Tangential section.

Text-figs. 14-16.—*Stenopora etheridgei*, n. sp. Thin sections of topotypes (6402 A-C, Sydney University Collection), × 10. 14. Longitudinal section. 15. Tangential section. 16. Transverse section.

Text-figs. 17-19.—*Stenopora parallela*, n. sp. Thin sections from specimens in the same piece of shale as the holotype, × 10. 17. Tangential section. 18. Transverse section. 19. Longitudinal section.

This species has finer branches than those of *Stenopora tasmaniensis* Lonsdale 1844, and is also distinguished from Lonsdale's specimens and from specimens described as *S. tasmaniensis* by Bassler (1941, 173) by its far more abundant acanthopores, and by its proportionately much wider mature zone with more numerous rows of monilae.

STENOPORA PARALLELA, n. sp. Text-figs. 17–19.

Holotype: 2437, Sydney University Collection.

Locality: Huon Rd., Mt. Wellington, Tasmania, 1,000 ft. above sea-level (holotype); same horizon, "Mt. Wellington" of Strzelecki, Strickland Ave. track, 1 mile west of Cascade (2438, Sydney University Collection).

Ramose Stenopora; *walls strongly thickened, with weakly-developed monilae, in the peripheral zone, and thin except where crossed by arcuate rows of monilae in the axial zone; zooecial tubes without diaphragms; mesopores rare; acanthopores of two sizes, fairly abundant.*

The zoarium is ramose, with cylindrical branches about 4·5 mm. in diameter, which bifurcate at distant intervals. The surface of the zoarium is smooth, neither monticules nor maculae being developed. The zooecial apertures are oval, with their longer axes parallel to the length of the branches, and are from 0·32 to 0·46 mm. long and from 0·17 to 0·24 mm. wide. The interspaces between adjacent apertures are rounded, and acanthopores are not often developed. Mesopores are rare; they are oval with their long axes parallel to the length of the branches, and are up to 0·18 mm. long and 0·1 mm. wide. The apertures are arranged in longitudinal (sometimes rather oblique) and poorly defined diagonal rows; about 9 apertures occur longitudinally in 10 mm., and in a field of 7 sq. mm. there are 34 to 40 zooecia and about 5 mesopores. Small solid maculae occasionally occur.

The peripheral zone has a radius of 0·75 to 1·0 mm., and the bend from the axial to the peripheral region is at an angle of about 45°. In the axial zone the tubes are very thin-walled, and are angular in cross-section; this zone is crossed by an occasional arcuate row of monilae. In the peripheral zone the walls are 0·08 to 0·28 mm. thick; monilae are rather weakly developed. No diaphragms occur. The acanthopores are of two sizes; up to five, but generally fewer, large acanthopores occur around each aperture; the smaller acanthopores are more abundant, but are irregularly developed.

STENOPORA ETHERIDGEI, n. sp. Pl. ii, fig. 4; Text-figs. 14–16.

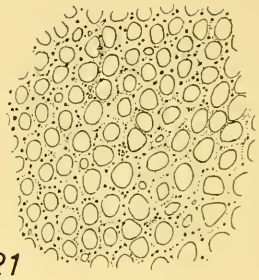
Holotype: 5434, Sydney University Collection.

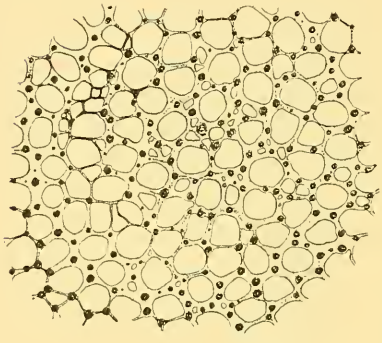
Horizon and locality: Allandale Stage, Lower Marine Series, Jackson's Hill, Por. 132, Par. Pokolbin; same stage, Por. 7, Par. Allandale, where road from Allandale to Rothbury crosses Black Ck.—horizon a of Walkom, 1913, 122 and Pl. ix (5435, Sydney University Collection).

Fine ramose Stenopora, *with oval apertures arranged in rough longitudinal and diagonal rows; no maculae or monticules; mesopores rare; acanthopores numerous, in a single row on the interspaces; peripheral zone narrow, with moniliform walls.*

The zoarium is ramose; the branches are cylindrical, but because of the great relative width of the axial zone they are readily crushed, and usually appear flattened. Uncrushed specimens are about 3·5 to 4·5 mm. in width; the width of flattened specimens is increased up to 5·5 mm. The zooecial apertures are oval, usually from 0·31 to 0·4 mm. long, although apertures up to 0·54 mm. long occur, and they are 0·13 to 0·24 mm. wide. They are not regularly arranged, although they may in places form rough longitudinal or diagonal rows. Small mesopores occasionally occur. There are no monticules nor maculae. In 7 sq. mm. there are about 31 to 36 zooecia, and 0 to 5 mesopores. Blunt acanthopores of two sizes, of which the larger are very much the more numerous, occur in a single row on the interspaces between the apertures; there are usually from 12 to 15 around each aperture at the surface.

The zooecial walls are strongly thickened in the mature zone, which is from 0·47 to 0·8 mm. wide, and in this distance there are usually three to five rows of almost confluent monilae; occasional arcuate rows of single monilae cross the axial zone, in which the zooecial tubes are usually very thin-walled. The tubes bend gradually from the axial to the mature zone. No diaphragms occur.





Text-figs. 20-21.—*Stenodiscus moniliformis*, n. sp. Thin sections of the holotype, × 10. 20. Longitudinal section. 21. Tangential section, passing partly through a monticule.

Text-figs. 22-23.—*Stenopora pustulosa*, n. sp. Thin sections of the holotype, × 10. 22. Tangential section, passing through a monticule near the centre of the diagram. 23. Longitudinal section.

Stenopora johnstoni Etheridge, 1891. Text-figs. 24, 25.

Stenopora johnstoni Etheridge, 1891, Pl. vii, fig. 7, and p. 59; *Stenopora johnstoni* Etheridge, Hummel, 1915, 74, T. viii, figs. 4, A, B.

Neotype: The slide figured by Etheridge, and the specimen from which it was made (here considered the type of the species), are lost. Since this specimen was collected from Tasmania, from either Porter's Bay or Maria Island, specimen 5433, Sydney University Collection, from the marine beds which outcrop along the shore below the fresh water Porter's Hill Beds, is selected as neotype.

Horizon and locality: Tasmania: Marine beds just below fresh water Porter's Hill Beds, on shore below Porter's Hill, Sandy Bay, near Hobart (holotype); just above Eurydesma horizon, Darlington, Maria Island (recorded by Etheridge and Hummel); New South Wales: Allandale Stage, Lower Marine Series, Por. 34, Par. Middlehope, near Eelah Road crossing of North Coast Railway (5432, Sydney University Collection), same Stage, above Eurydesma Conglomerate in railway cutting east of Allandale Station (5443, Sydney University Collection); same Stage, "Maluna", Pokolbin (F 12233, Australian Museum Collection).

Frondescent Stenopora, *zoaria rather thin, flattened, often of large extent; tube walls with numerous crowded monilae in the mature zone, axial zone with arcuate rows of*

monilae; acanthopores numerous, in a single row on the interspaces; mesopores not abundant; diaphragms absent; inconspicuous monticules developed on the surface.

The zoaria are frondescent, arising from small encrusting bases; typically they appear about 4 to 5 mm. thick—the axial zone is readily crushed, and this has usually reduced the thickness of the zoaria considerably, perfect zoaria being about 11 mm. thick; the thickness of the colony has in some specimens been increased by overgrowths on the surface, where part of the colony has been rejuvenated; the zoaria taper gradually near the growing tip of the frond. The largest zoarium examined (from near Eelah) is an incomplete undulating frond about 12 cm. long and 5·5 cm. wide. Very slightly raised monticules, up to 3 mm. in diameter and with their centres spaced 6 to 10 mm. apart, occur rather regularly on the surface. The zooecia are much thicker-walled, the acanthopores more crowded, and the mesopores usually more abundant in these monticules.

The zooecia are tubular, and the apertures are usually rather elongated parallel to the direction of growth. The tubes are sub-circular to oval in section at the level of the monilae, where their size usually ranges (in specimens from the type locality) from about 0·24 to 0·33 × 0·36 to 0·45 mm., although groups of larger zooecia occur. The thickness of the walls at the level of the monilae is usually about 0·15 mm., but may be up to 0·25 mm.; between the monilae the walls are very thin, and when the zooecia are cut at this level they are angular and are proportionately larger. The mesopores are similarly either sub-circular or angular in cross-section when cut at different levels; they vary, when cut at the level of the monilae, from a very small size up to about 0·25 × 0·17 mm. in diameter. Large acanthopores are abundant, usually in a single row, in the zooecial walls, up to about 18 surrounding each aperture; a few of these acanthopores are usually very much smaller than the majority. No diaphragms occur in the neotype, but extremely infrequent complete diaphragms occur in some of the sections of other specimens. The central thin-walled part of the zoarium is readily crushed; in the few specimens with this central part better preserved, its width is up to about 5·5 mm. Arcuate rows of thickening, each composed of a single row of monilae, cross this central part. Monilae are closely crowded and often confluent in the walls in the mature zone; in the neotype, this zone is 1·5 to 2·2 mm. thick and 10 to 14 rows of monilae occur in this distance; similarly crowded monilae occur where the thickness of a zoarium has been increased by overgrowths. In specimens in which the thickness of the zoarium is greater than in the neotype, the width of the mature zone and the number of rows of monilae are proportionately increased. There are from 23 to 38 zooecia, and from 1 to 10 mesopores, in 7 sq. mm. in specimens from the type locality; in specimens from Eelah, there are 25 to 42 zooecia, and 3 to 23, but usually less than 8, mesopores in the same area. Mesopores do not appear as abundant at the surface as in sections, probably due to infilling.

Stenopora frondescens Crockford, 1943, from the Westley Park Tuffs of the Upper Marine Series at Gerringong, is similar in the form of its zoarium to this species, but differs widely in the details of its external, as well as its internal, structure. *Stenopora spiculata*, n. sp., which occurs with this species at Eelah, is a massive form, but does show a general resemblance to this species in some details of its internal structure; in it, however, the zooecia are rounded rather than oval, the acanthopores smaller and less numerous, the mesopores more generally abundant, and the monilae are larger in the axial zone and are more widely spaced in the mature zone.

Genus Stenodiscus, n. gen.

Stenopora Lonsdale, Lee, 1912, 147; Bassler, 1929, 54; [non] *Stenopora* Lonsdale, 1844, 178; [non] *Stenopora* Lonsdale, Bassler, 1941, 173.

Ramose Batostomellidae, internal structure as in Stenopora, *except that thin complete diaphragms occur fairly frequently in the zooecial tubes.*

Range: Carboniferous to Permian.

Genotype: *Stenodiscus moniliformis*, n. sp.

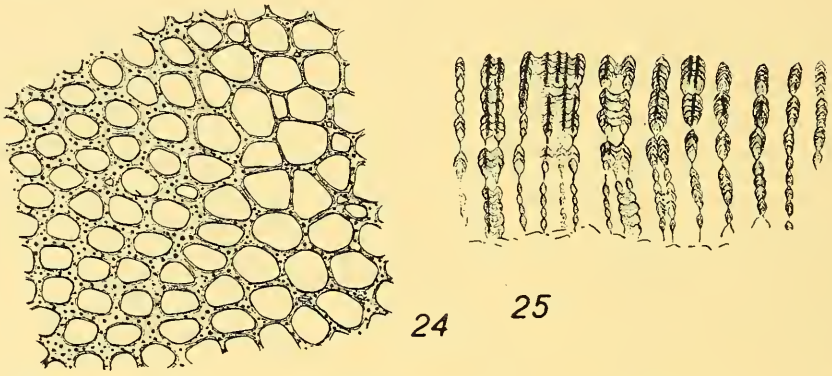
STENODISCUS MONILIFORMIS, n. sp. Pl. iii, figs. 1–3; Text-figs. 20, 21.

Holotype: F 37475, Australian Museum Collection.

Horizon and locality: Berriedale Limestone, Collinsvale Quarry, near Hobart, Tasmania.

Ramose Stenodiscus, *with broad mature zone, in which the tube walls are strongly moniliform; surface with inconspicuous monticules; acanthopores small, fairly numerous, in a single row in the interspaces; mesopores not abundant; thin, complete diaphragms of frequent occurrence.*

The zoarium is ramose, with cylindrical branches, circular to sub-circular in cross-section, and from 13 to 17 mm. in diameter. Incomplete specimens are up to 10 cm. long; bifurcation of the branches occurs at distant intervals. The surface is in general smooth, but inconspicuous, irregularly placed monticules, 2 to 5 mm. in diameter, occur; these are only very slightly raised, but in them the zooecia are larger and thicker-walled than usual, and the mesopores are rather more abundant. The interspaces between the zooecia at the surface are flat or slightly rounded, and the acanthopores are not prominent.



Text-figs. 24-25.—*Stenopora johnstoni* Etheridge. 24. Tangential section of a topotype (6403, Sydney University Collection), × 10. 25. Longitudinal section of the neotype, × 10.

The zooecia are tubular, sub-circular in section; the tube-walls are thin, except where they are crossed by remote arcuate zones of small single monilae, in the axial zone, which comprises one-half to one-third of the radius; the tubes bend gradually to the mature zone, in which moniliform thickenings are strongly developed. In section the monilae are pear-shaped, with their greatest thickness (usually up to 0·17 mm., but sometimes more) near their upper ends; they are very crowded, there being about 18 rows of monilae in the outer 3 mm. of the colony. At the level of the monilae the zooecia are normally from about 0·19 to 0·29 × 0·14 to 0·22 mm. in diameter, but the zooecia in the monticules are considerably larger, being up to 0·43 mm. in their longer and 0·38 mm. in their shorter diameter; in the thin-walled zones between the monilae the zooecia are proportionately larger. Small mesopores of varying size occur occasionally. Normally there are from 70 to 75 zooecia, and about 4 to 8 mesopores, in 7 sq. mm., but where a monticule is included in the field there are from 48 to 58 zooecia, and 8 to 19 mesopores, in the same area. Small acanthopores, rather granular in appearance, occur generally in a single row in the interspaces between the zooecia; up to 12 occur around each aperture. Thin, slightly concave, complete diaphragms are frequently developed in the tubes. The growth of the zoaria has in places been discontinuous, two or three successive layers of zooecia frequently occurring around part of the mature zone; these do not increase the size of the zoarium, but serve to bring the surface, in parts of the colony in which growth has been interrupted, up to the general level of the surface. In specimens of this species, the axial thin-walled zone has frequently been crushed, or else broken down, the space so formed being filled either with clear calcite or with fine sediment.

Brown masses comparable to those described by Cummings and Galloway (1915, 351), but which are not enclosed by cysts, although they are usually resting upon a diaphragm, are rather commonly shown in the zooecial tubes of specimens of this species; in addition to these larger brown masses, smaller rounded (occasionally elongate) brownish globules, about 0·15 mm. in diameter, frequently occur, mostly in groups immediately above a diaphragm; although these structures are not described in detail here, photographs of them are given on Pl. iii.

Stenoporids in which complete diaphragms are developed have been described from the Carboniferous of Great Britain and North America, and the Permian of India, Russia and Timor, but none of the species so far described compares closely with this species in the details of its internal structure.

Summary.

In this paper ten species of Stenoporids are described and figured from the Permian of New South Wales and Tasmania; of these, seven are described as new species of *Stenopora* Lonsdale, and revision is made of two previously described species of *Stenopora*, *S. crinita* Lonsdale, 1844, and *S. johnstoni* Etheridge, 1891; one species from the Permian of Tasmania is described as the type of *Stenodiscus*, n. gen.; a discussion is also given of the frequently recorded *Stenopora ovata* Lonsdale, 1844. In addition, a short general discussion of the occurrence and distribution of Bryozoa in the Eastern Australian Permian is included in the introduction.

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EXPLANATION OF PLATES II-III.

Plate ii.

Fig. 1.—*Stenopora rugosa*, n. sp. Part of the surface of the holotype, × 1.

Figs. 2-3.—*Stenopora pustulosa*, n. sp. 2. Topotype (5437, Sydney University Collection), showing the prominent monticules characteristic of this species, × 1. 3. Holotype, × 1; the monticules are less prominent in this specimen, since the surface is rather weathered.

Fig. 4.—*Stenopora etheridgei*, n. sp. Holotype, × 1; the furrow along the centre of each branch is caused by the crushing and flattening of the zoarium.

Fig. 5.—*Stenopora johnstoni* Etheridge. Surface of a small part of a topotype (F 2702, Australian Museum Collection), showing the large but only slightly raised monticules.

Fig. 6.—*Stenopora hirsuta*, n. sp. Holotype, × 1. (A small fragment of a very fine ramose zoarium, indicated by an arrow, belongs to a species of *Streblotrypa*; this genus has not previously been recorded from Eastern Australia, although it is very abundant in the Permian of Western Australia and Timor.)

Plate iii.

Figs. 1-3.—*Stenodiscus moniliformis*, n. sp. 1. Part of the holotype, × 1. 2. Longitudinal section of the holotype, × 20. 3. Tangential section of the holotype, × 20. The large brown masses and smaller brown globules which are commonly shown in thin sections of specimens of this species are shown in these last two photographs.

Fig. 4.—*Stenopora spiculata*, n. sp. Tangential section of the holotype, × 20.